

CLAIMS

1. A method of forming an aluminum-comprising physical vapor deposition
2 target, comprising:
 - 3 deforming an aluminum-comprising mass by equal channel angular
4 extrusion, wherein the mass is at least 99.99% aluminum and further
5 comprises less than or equal to about 1000 ppm of one or more dopant
6 materials comprising elements selected from the group consisting of Ac, Ag,
7 As, B, Ba, Be, Bi, C, Ca, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf,
8 Ho, In, Ir, La, Lu, Mg, Mn, Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr,
9 Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm,
10 V, W, Y, Yb, Zn and Zr;
11 after the deforming, shaping the mass into at least a portion of a physical
12 vapor deposition target.
1. 2. The method of claim 1 wherein the physical vapor deposition target is a
2 monolithic target.
1. 3. The method of claim 1 wherein the one or more dopant materials comprise
2 materials selected from the group consisting of B, Ba, Be, Ca, Ce, Co, Cr, Dy, Er,
3 Eu, Gd, Ge, Hf, Ho, La, Ni, Nd, Pd, Pm, Pr, Sb, Sc, Si, Sm, Sr, Tb, Te, Ti, Tm, Y,
4 Yb and Zr.
1. 4. The method of claim 1 wherein the one or more dopant materials comprise
2 materials selected from the group consisting of Si, Sc, Ti and Hf.
1. 5. The method of claim 1 wherein the mass consists of aluminum and from
2 about 10 ppm to about 100 ppm of the one or more dopant elements.

1 6. The method of claim 1 wherein the mass consists of Al and from about 10
2 ppm to about 100 ppm of one or more of Si, Sc, Ti, and Hf.

1 7. The method of claim 1 wherein the mass consists of Al and from about 10
2 ppm to about 100 ppm of Hf.

1 8. The method of claim 1 wherein the mass consists of Al and from about 10
2 ppm to about 100 ppm of Ti.

1 9. The method of claim 1 wherein the mass consists of Al and from about 10
2 ppm to about 100 ppm of Sc.

1 10. The method of claim 1 wherein the mass consists of Al and from about 10
2 ppm to about 100 ppm of Si.

1 11. A method of forming an aluminum-comprising physical vapor deposition
2 target, comprising:
3 deforming an aluminum-comprising mass by equal channel angular
4 extrusion; and
5 after the deforming, shaping the mass into at least a portion of a physical
6 vapor deposition target, the physical vapor deposition target having an
7 average grain size less than or equal to 45 microns.

1 12. The method of claim 11 wherein the mass is formed into an entirety of the
2 physical vapor deposition target, and further comprising mounting the mass to a
3 backing plate.

1 13. The method of claim 11 wherein the mass is at least 99.99% aluminum and
2 consists of Al and less than 100 ppm of one or more of Si, Sc, Ti and Hf.

1 14. The method of claim 11 wherein the mass is at least 99.99% aluminum, and
2 further comprises greater than 0 ppm and less than or equal to about 100 ppm of
3 one or more dopant materials comprising elements selected from the group
4 consisting of Ac, Ag, As, B, Ba, Be, Bi, C, Ca, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe,
5 Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu, Mg, Mn, Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd,
6 Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl,
7 Tm, V, W, Y, Yb, Zn and Zr.

1 15. The method of claim 11 wherein the mass consists essentially of aluminum.

1 16. The method of claim 11 wherein the mass consists essentially of aluminum,
2 and less than or equal to about 100 ppm of one or more dopant materials
3 comprising elements selected from the group consisting of Ac, Ag, As, B, Ba, Be,
4 Bi, C, Ca, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu,
5 Mg, Mn, Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru,
6 S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm, V, W, Y, Yb, Zn and Zr.

1 17. The method of claim 11 wherein the shaping comprises one or more of
2 forging and rolling of the aluminum-comprising mass at a temperature of less than
3 or equal to about 200°C.

1 18. The method of claim 11 wherein the deforming comprises at least three
2 extruding steps, each of the at least three extruding steps comprising passing the
3 mass through two intersecting passages having approximately equal cross-sections.

1 19. The method of claim 11 wherein the deforming comprises at least four
2 extruding steps, each of the at least four extruding steps comprising passing the
3 mass through two intersecting passages having approximately equal cross-sections.

1 20. The method of claim 11 wherein the deforming comprises at least six
2 extruding steps, each of the at least six extruding steps comprising passing the
3 mass through two intersecting passages having approximately equal cross-sections.

1 21. A physical vapor deposition target consisting essentially of aluminum and
2 less than or equal to 1000 ppm of one or more dopant materials comprising
3 elements selected from the group consisting of Ac, Ag, As, B, Ba, Be, Bi, C, Ca,
4 Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu, Mg, Mn,
5 Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc,
6 Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm, V, W, Y, Yb, Zn and Zr; the physical
7 vapor deposition target having an average grain size of less than 100 microns.

1 22. The physical vapor deposition target of claim 21 having an average grain size
2 of less than or equal to 45 microns.

1 23. The physical vapor deposition target of claim 21 consisting of Al and less
2 than 100 ppm of one or more of Si, Sc, Ti; and Hf.

1 24. The physical vapor deposition target of claim 21 consisting of Al and from
2 10 ppm to 100 ppm of one or more of Si, Sc, Ti; and Hf.

1 25. The physical vapor deposition target of claim 21 consisting of Al and from
2 10 ppm to 100 ppm of Sc; the target having an average grain size of less than or
3 equal to 45 microns.

1 26. The physical vapor deposition target of claim 21 consisting of Al and from
2 10 ppm to 100 ppm of Si; the target having an average grain size of less than or
3 equal to 35 microns.

1 27. The physical vapor deposition target of claim 21 consisting of Al and from
2 10 ppm to 100 ppm of Ti.

1 28. The physical vapor deposition target of claim 21 consisting of Al and from
2 10 ppm to 100 ppm of Hf.

1 29. A film sputtered from a target, the film consisting essentially of aluminum
2 and less than or equal to 1000 ppm of one or more dopant materials comprising
3 elements selected from the group consisting of Ac, Ag, As, B, Ba, Be, Bi, C, Ca,
4 Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu, Mg, Mn,
5 Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc,
6 Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm, V, W, Y, Yb, Zn and Zr.

1 30. The film of claim 29 consisting of Al and less than 100 ppm of one or more
2 of Si, Sc, Ti and Hf.

1 31. The film of claim 29 consisting of Al and from 10 ppm to 100 ppm of one or
2 more of Si, Sc, Ti and Hf.